DOCUMENT RESUME

ED 152 564 SE 024 097

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TITLE A Guide for Developing Standard Operating Job Procedures for the Tertiary Multimedia Filtration Process Wastewater Treatment Facility. SOJP No. 7.
INSTITUTION Charles County Community Coll., La Plata, Md.
SPONS AGENCY Environmental Protection Agency, Washington, D.C. Div. of Manpower Training.
PUB DATE Jun 75
GRANT EPA-900253
NOTE 127p.; For related documents, see SE 024 091-096

EDRS PRICE MF-$0.83 HC-$7.35 Plus Postage.
DESCRIPTORS *Guides; Health Occupations; Industrial Training; *Job Training; Safety; Technical Reports; *Utilities; *Waste Disposal; Water Pollution Control; *Water Resources

ABSTRACT

This guide describes the standard operating job procedures for the tertiary multimedia filtration process of wastewater treatment plants. The major objective of the filtration process is the removal of suspended solids from the reclaimed wastewater. The guide gives step-by-step instructions for pre-start up, start-up, continuous operation, and shut-down procedures. In addition, some theoretical information and mathematical calculations are given. (BB)

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SOJP NO 7

TERTIARY MULTIMEDIA FILTRATION

A GUIDE FOR THE DEVELOPMENT OF

STANDARD OPERATING JOB PROCEDURES

FOR WASTE WATER TREATMENT PLANT UNIT OPERATIONS

DEVELOPED BY
CHARLES COUNTY COMMUNITY COLLEGE
LA PLATA, MARYLAND

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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STANDARD OPERATING JOB PROCEDURE VII

TERTIARY MULTIMEDIA FILTRATION

DALLAS ENVIRONMENTAL ENGINEERING TRAINING CENTER

by

AL PETRASEK, JR.

JUNE 1975

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1. Objectives

The major objective of the filtration process is the removal of suspended solids from the reclaimed wastewater. Depending on the location of the filtration process, these suspended solids may be either biological or chemical floc that were not removed by sedimentation. If granular activated carbon is used in the plant, filtration will usually precede the carbon contactors to extend the life of the activated carbon. This is especially true if chemical treatment is not used in the plant.

2. Description

In the filtration unit operation the water which is being filtered (generally a settled secondary effluent or a chemically treated and clarified effluent) is passed through a bed of filter media which "strains" out the suspended solids in the wastewater. The filtering media can be several different types of material, but most often sand, anthracite, or garnet are used. The preferred media for wastewater reclamation consists of either sand and anthracite, or sand, anthracite, and garnet.

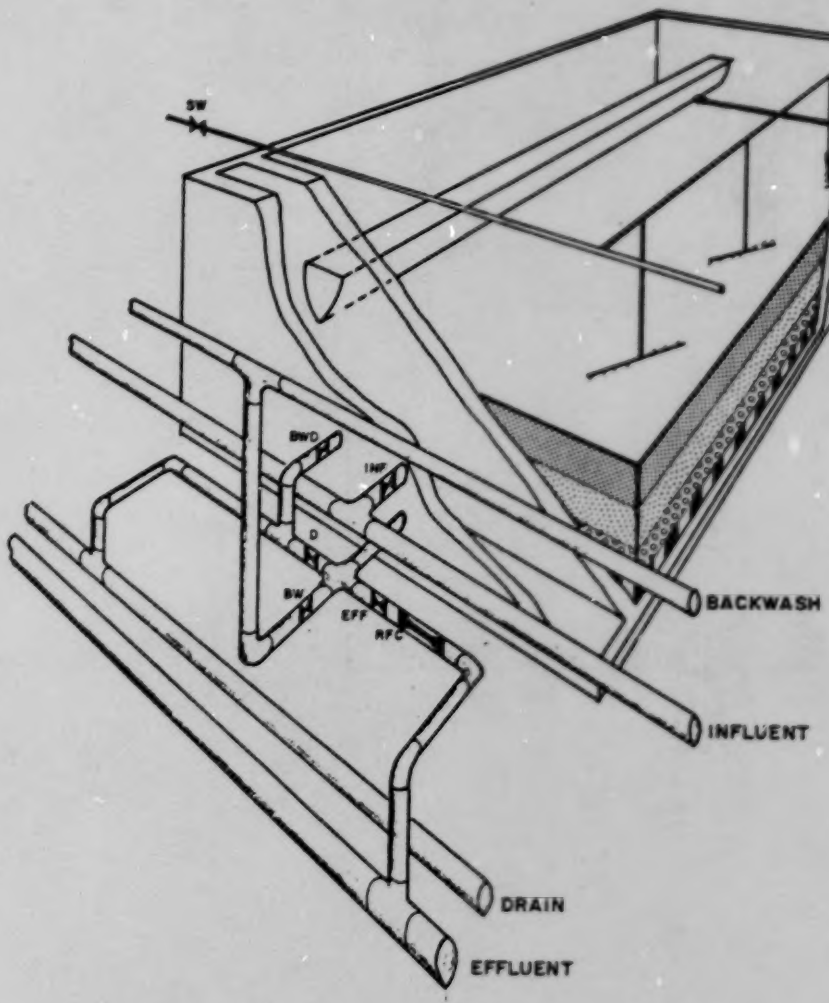
As the filter processes more water the bed of media "gets dirty" and more head loss across the filter develops as a result of the accumulation of the suspended solids removed from the wastewater. When the head loss gets to a certain level, generally 8 to 10 feet for gravity filters, the bed must be cleaned. The cleaning process is called backwashing. During the backwashing flow through the filter is reversed and the suspended solids that were trapped in the bed are washed out.

At the end of the backwash the filter is returned to normal operation.

3. Process Equipment

The gravity flow filters consist of concrete boxes with tile underdrain blocks that are covered with graded gravel. The gravel supports a 24-inch deep layer of filter sand, and an 18-inch layer of anthracite overlays the sand.

All valve controls are pneumatic, with manual override. Flow measurement is with magnetic flow meters, and all filters are equipped with surface-scatter turbidimeters to monitor effluent quality. Conventional rate of flow controllers are installed on all effluent lines.



SW — SURFACE WASH

BWD — BACKWASH DRAIN

INF — FILTER INFLUENT

D — DRAIN

BW — BACKWASH

EFF — FILTER EFFLUENT

RFC — RATE OF FLOW CONTROLLER

FILTER 2
FILTER
FILTER 1
FILTER 3
INFLUENT
EFFLUENT
BACKWASH
SURFACE WASH
DRAIN
METER
PUMP

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRESTART UP PROCEDURES			
1. Safety Inspection	1. Inspect control consoles for Filters No. 1, 2, 3, and 4.	1. All valves closed and tagged.	XII-1
	2. Inspect filter influent valves, 11, 21, 31, and 41.	1. Be sure the valve is closed.	
	3. Inspect filter effluent valves 12, 22, 32, and 42.	1. Be sure the valve is closed.	
	4. Inspect filter backwash valves 13, 23, 33, and 43.	1. Be sure the valve is closed.	
	5. Inspect surface wash valves 15, 25, 35, and 45.	1. Be sure the valve is closed.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRESTART UP PROCEDURES (Cont.)			
	6. Open filter drain valves 14,24,34, and 44.	1. Tag the switch on the control console. 2. To keep the filter drained.	
	7. Inspect drain valves 14,24,34, and 44.	1. To be sure they are open.	
	8. Inspect breakers for filter control consoles.	1. Off, locked, and tagged.	
	9. Inspect isolation valves 51 and 52, for backwash water pump.	1. Closed and tagged.	
	10. Inspect isolation valves 53 and 54, for surface wash pump.	1. Closed and tagged.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRESTART UP PROCEDURES (Cont.)			
	11. Inspect breakers for backwash water pump.	1. Off, locked, and tagged.	
	12. Inspect breakers for surface wash pump.	1. Off, locked, and tagged.	
	13. Inspect chlorine solution valves 17, 27, 37, and 47.	1. Closed and tagged.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRESTART UP PROCEDURES (Cont.)			
2. Filter Inspection	1. Inspect washwater troughs.	1. Clean and free of all debris.	
	2. Inspect filter gullet.	1. Clean and free of all debris.	
	3. Inspect media surface.	1. Free of all debris. 2. Smooth and level.	
	4. Measure distance from trough to surface of media.	1. From the lip of the trough. 2. These data will be used later to determine if any media have been lost.	V-1
	5. Inspect surface of filter media for fines.	1. Excessive fines will produce zones of high head loss in a filter. The fines should be removed by skimming with a shovel.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRESTART UP PROCEDURES (Cont.)			
3. Equipment Inspection	1. Inspect surface wash rotors.	1. Should spin freely. 2. Clearance between rotors and the surface of the media should be about 2 inches. 3. There should not be excessive play in the bearings in the hub. 4. Nozzles clear and clean.	
	2. Inspect backwash water pump and motor.	1. Shafts rotate freely. 2. Shafts properly aligned and coupling in good repair. 3. Properly lubricated -- see Manufacturer's Data Sheet. 4. No evidence of leaking seals.	
	3. Inspect surface wash pump and motor.	1. Shafts rotate freely. 2. Shafts properly aligned and coupling in good repair. 3. Properly lubricated -- see Manufacturer's Data Sheet. 4. No evidence of leaking seals.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRESTART UP PROCEDURES (Cont.)			
	4. Inspect control consoles.	1. Drain valve No. 6 and backwash drain valve No. 4 open. 2. All other valves closed.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES			
1. Process Instrumentation	1. Turn on power to backwash water flow meter and recorder.	1. Circuit breakers in the power distribution panel, or a sub-panel. 2. The recorder has a switch inside the cabinet.	
	2. Set circular chart recorder to correct time and day.	1. This is a seven-day chart. 2. Rotate chart until pen is in desired location, after releasing the clamp in the center.	
	3. Turn on power to the surface wash flow meter and recorder.	1. Circuit breakers in the power distribution panel, or a sub-panel. 2. The recorder has a switch inside the cabinet.	
	4. Set circular chart recorder to the correct time and day.	1. This is a seven-day chart. 2. After releasing the clamp in the center, rotate chart until the pen is in the desired location.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES (Cont.)			
	5. Turn on power to turbidimeters and recorders.	1. Circuit breakers in power distribution panel, or a sub-panel. 2. The strip chart recorder has a switch inside the case.	
	6. Set the chart to the proper time.	1. By advancing the chart until the proper time is at the pen location. 2. BE SURE TO WRITE THE DATE ON THE CHART.	
	7. Calibrate the turbidimeters.	1. See Manufacturer's instructions.	
	8. Turn on power to loss of head recorders.	1. Circuit breakers in power distribution panel, or a sub-panel. 2. The recorder has a switch inside the case.	
	9. Set the strip chart to the desired time.	1. BE SURE TO WRITE THE DATE ON THE CHART.	26

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES (Cont.)			
	10. Turn on the power to the rate of flow recorder.	1. Circuit breakers in the power distribution panel or a sub-panel. 2. The recorder has a switch inside the cabinet.	
	11. Set the circular chart to the correct time and day.	1. This is a seven-day chart. 2. After releasing the clamp in the center, rotate the chart until the pen is in the desired location.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES (Cont.)			
2. Preparation For First Filter Backwash	1. Turn on power to filter control console.	1. Circuit breakers in power distribution panel.	
	2. Turn on power to backwash and surface wash pumps.	1. Circuit breakers in high voltage distribution panel.	
	3. Open isolation valves for backwash water pump; Nos. 51 and 52.		
	4. Open isolation valves for surface wash pump; Nos. 53 and 54.		
	5. Check level in backwash water storage tank.	1. To verify that there is enough water to backwash the filter -- at least 200,000 gallons.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES (Cont.)			
	6. Check level in backwash water surge tank.	1. To verify that there is enough room to store the waste backwash water -- at least 200,000 gallons.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES (Cont.)			
3. First Filter Backwash	1. Close filter drain, valve No. -6.		
	2. Start backwash water pump.		
	3. Open backwasn water valve No. -3.	1. VERY SLOWLY -- KEEP FLOW LESS THAN 2 gpm/sq.ft.	V-2
	4. Allow filter to fill with backwash water.	1. Until flow into the backwash water troughs has been established. 2. During this time, observe the large amount of air escaping from the filter media.	
	5. Start the surface wash pump.		
	6. Open the surface wash valve No. -5.	1. Set flow to about 1 gpm/sq.ft.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START UP PROCEDURES (Cont.)			
	7. Increase backwash water flow.	1. Very slowly, and in increments of about 5 gpm/sq.ft. Flow should only be increased after almost all of the air has escaped from the filter media.	V-3
		2. Maximum backwash water flow will be between 17 and 23 gpm/sq.ft.	V-4
	8. Complete backwashing the filter.	1. After the backwash water flow has been increased to maximum, continue washing the filter until: a. All air has been washed from media. b. The backwash water appears clean. c. Ten (10) minutes have passed. Be sure that conditions a and b are satisfied if you want a good, clean filter.	V-5
	9. Close surface wash valve No. -5.	1. About 2 minutes before stopping the backwash water.	
	10. Turn off surface wash pump.		

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B. START UP PROCEDURES (Cont.)			
	11. Close backwash water valve No. -3.	1. Slowly, so the media have a chance to become hydraulically graded.	
	12. Turn off the backwash water pump.		
	13. Close the backwash water drain valve No. -4.		

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B. START UP PROCEDURES (Cont.)			
4. Putting the Filter in Service	1. Open filter influent valve No. 1.		
	2. Open filter effluent valve No. -2.		
	3. Set rate of flow controller.	1. At desired filtration rate. Usually between 3 and 7 gpm/sq.ft. for wastewater treatment plants.	I-3
		2. Record in Operator's Log.	XIII-2
	4. Check initial loss of head.	1. This should be less than 24 inches, and usually between 12 and 18 inches. High initial head losses indicate difficulties in filter operations which can require extensive maintenance. *See Abnormal Operations - High Initial Loss of Head.*	VII-2
		2. Record in Operator's Log.	XIII-2

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
B. START-UP PROCEDURES (Cont.)			
	5. Observe effluent turbidity.	1. Record in Operator's Log. 2. For chemically coagulated waters, the turbidity of the filtered water should be less than 1 JTU. Under normal conditions the turbidity will range from about 0.2 to 0.7 JTU.	VI-1 VII-3 XI-1 I-1 I-2 XIII-2 III-1
	6. Fill in Operator's Log.	1. Time filter was put in service. 2. Total gallons of wash water used. 3. Total gallons of surface wash water used. 4. Total time required for the filter backwash. 5. Maximum backwash flow used.	XIII-2 IV-1

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION			
1. Two-hour Inspection	1. Check and record loss of head on all filters.	1. Take readings from control consoles. 2. Record in Operator's Log. 3. A head loss approaching 9 feet indicates the filter will have to be backwashed in a few hours.	
	2. Check and record filtration rate on all filters.	1. Take readings from the control consoles. 2. Record in Operator's Log. 3. Once set, the filtration rate should not change appreciably.	VII-1 XI-2
	3. Check effluent turbidity on all filters.	1. Take the reading directly from the turbidity meter. 2. Record in the Operator's Log. 3. Effluent turbidity values should be less than 1.0 JTU.	
	4. Observe water on top of filters.	1. The turbidity should be about 3-6 JTU. 2. It should be possible to see the surface wash sweeps. 3. The water should appear well coagulated.	

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C. CONTINUOUS OPERATION (Cont.)			
45	5. Record hours of service since last backwash for each filter.	1. Regardless of the head loss, most filters are backwashed after they have been in service for 60 to 80 hours. 2. Record in Operator's Log.	46

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C. CONTINUOUS OPERATION (Cont.)			
2. *Two-hour Inspection-Abnormal Operations*	1. *General Response.*	1. *For this process to operate properly, the water to be filtered must be properly coagulated and flocculated. In many cases poor quality in the filtered water can be traced to a loss of process control in the chemical treatment system.* 2. *Problems in filter operation can require extensive maintenance and down time.*	VII-3
	2. *See ABNORMAL OPERATIONS*	1. *High initial loss of head.* 2. *High effluent turbidity.* 3. *Surface wash arms do not rotate.*	

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C. CONTINUOUS OPERATION (Cont.)			
3. Four-hour Inspection	1. Perform all job steps listed for the two-hour inspection.	1. To assure proper operation.	
	2. Inspect backwash pump and motor.	1. Check for worn bearings, leaking seals, worn couplings, shafts out of alignment, etc. 2. Note any possible maintenance problems on the Operator's Log.	IX-1
	3. Inspect surface wash pump and motor.	1. Check for worn bearings, leaking seals, worn couplings, shafts out of alignment, etc. 2. Note any possible maintenance problems on the Operator's Log.	
	4. Collect a sample of effluent from the filters.	1. One grab sample for each filter. 2. Collect the sample carefully, allowing the sample tap to flush for about 20-30 seconds before collecting the sample. 3. Use only clean sample containers.	

4.

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
	5. Perform a turbidity analysis.	1. Using a laboratory turbidity meter, or any other suitable technique. 2. The turbidity should be less than 1.0 JTU.	X-1
	6. Compare the results of the turbidity measurement on the grab sample with the reading given by the on-line turbidity meter.	1. The readings do not have to agree exactly, since the methods of measurement (reflectance or transmission) can be different. 2. For filtered water the readings should agree $\pm$ 0.5 JTU.	
	7. Observe filter effluent samples.	1. There should not be any filter media present in the effluent samples. 2. The presence of sand or anthracite in the effluent is an indication of major problems with the filter.	
	8. Check filter loss of head.	1. Head loss should be increasing <u>slowly</u> on all filters. 2. In 4 hours the increase in head loss will be about ¼ to ½ foot of water.	

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C. CONTINUOUS OPERATION (Cont.)			
3a. Abnormal Operations-Four-hour Inspection	1. *See ABNORMAL OPERATIONS FOR:*	1. *Effluent turbidity readings do not check.* 2. *Filter media in the filter effluent.*	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
4. Once Per Shift	1. Perform all job steps listed for the two- and four-hour inspections.	1. To assure good operations.	
	2. Clean filter control consoles.	1. With a damp cloth.	
	3. Flush sample lines to effluent turbidity meters.		
	4. Calibrate all effluent turbidity meters.	1. See Manufacturer's Instructions. 2. Indicate calibration on the Operator's Log -- be sure to indicate on what scale the meter is operating.	XI-2
	5. Inspect all rate of flow controllers.	1. Be sure the actuator levers move freely.	

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C. CONTINUOUS OPERATION (Cont.)			
5. Once Per Day	1. Sweep and hose down the filter gallery.	1. To assure a neat appearance, and to provide safe working conditions.	
	2. Hose down walk to filter consoles.	1. To assure a neat appearance and to provide safe working conditions.	
	3. Compute total gallons of water filtered.	1. Record on Monthly Summary Sheet. 2. For each filter.	
	4. Compute total gallons of backwash water used.	1. For each filter. 2. Record on Monthly Summary Sheet.	
	5. Compute total gallons of surface wash water used.	1. For each filter. 2. Record on Monthly Summary Sheet.	
	6. Compute average effluent turbidity.	1. For each filter. 2. Use the readings taken from the on-line turbidimeters.	

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C. CONTINUOUS OPERATION (Cont.)			
		3. Record on the Monthly Summary Sheet.	
	7. Compute average effluent color values.	1. For each filter. 2. Record on the Monthly Summary Sheet.	
	8. Inspect all pumps, motors, etc., and clean if required.	1. To maintain a good appearance.	
	9. Inspect the lubrication on all pumps, motors, etc.	1. To minimize maintenance costs. 2. To minimize down time. 3. See Manufacturer's Data Sheet for details.	

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C. CONTINUOUS OPERATION (Cont.)			
6. Weekly Activities	1. Thoroughly inspect all equipment.	1. Look for items that require preventive maintenance.	
	2. Make repairs as required.	1. Submit a work order to the Maintenance Crew, or contact your supervisor.	
	3. Check lubrication schedules, and lubricate all equipment as required.	1. See Manufacturer's Data Sheet.	
	4. Cut grass in plant yard.	1. If required. 2. Supervise laborer to be sure the job is done properly.	
	5. Polish floor in the Control Room.	1. Supervise laborer closely, and assist as required.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
7. Monthly Activities	1. Complete Monthly Summary Sheets, and submit to your supervisor.	1. This should include relatively detailed operating information, and monthly averages for all important values.	II-4 II-5 II-6 XIII-1 XIII-2 XIII-3 IV-2
	2. Prepare a brief monthly operator's report.	1. Include comments about equipment maintenance difficulties, personnel problems, and any other comments that could be needed in the future.	
	3. Check lubrication schedules.	1. See Manufacturer's Data Sheet.	
	4. Have all equipment lubricated as required.	1. Coordinate with Maintenance Crew.	
	5. Fill out your discharge monitoring self-reporting form.	1. This is required by law. 2. Your supervisor will probably take care of this, but be sure someone is doing it.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
8. Quarterly Activities	1. Send in the Discharge Monitoring Self-Reporting Forms.	1. These forms are submitted every 90 days. 2. The addresses to which the forms are to be mailed are included in your Discharge Permit.	
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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
9. Backwashing Procedure	1. Determine if the filter needs to be backwashed.	1. Filters are usually backwashed when the head loss becomes excessive, when turbidity breakthrough occurs, or after some selected time period. a. For gravity filters maximum head loss is usually 8-10 feet. b. For chemically coagulated waters maximum filter runs are usually 60-80 hours.	
	2. Close influent valve, Valve No. -1.		
	3. Close effluent valve, Valve No. -2.		
	4. Open backwash water drain valve, Valve No. -4.		
	5. Start surface wash pump.		

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
	6. Open surface wash water valve, Valve No. -5.		
	7. Observe surface wash sweeps.	1. They should be rotating rapidly.	
	8. Start backwash water pump.	1. After the surface wash has been running about 2 minutes.	
	9. Open backwash water valve, Valve No. -3.	1. Very slowly. 2. Until the flow is about 5 gpm/sq.ft.	V-3
	10. Observe surface of the filter.	1. If air bubbles (in large numbers) are escaping from the filter media, wait until the air has been washed from the bed before increasing the backwash water flow.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
	11. Increase backwash water flow.	1. Slowly, observing the filter surface constantly. 2. Stop increasing the flow any time large amounts of air start escaping from the filter bed. 3. Increase the flow to a maximum of 15-21 gpm/sq.ft.	V-4
	12. Observe the backwash water in the troughs.	1. It should gradually become clearer, as the suspended solids trapped in the filter media are removed by the backwashing.	
	13. Observe the filter surface.	1. Flow should be uniformly distributed over the filter surface.	
	14. Collect samples of of the backwash water.	1. Three 100 ml samples. One at the start of the backwash, another about halfway through the backwash, and the final sample just before stopping the backwash. 2. These samples should be analyzed for total suspended solids.	

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C. CONTINUOUS OPERATION (Cont.)			
	15. Observe the samples collected.	1. There should be no filter media present in the backwash water.	
	16. Close the surface wash valve, Valve No. -5.	1. About 2 minutes before stopping the backwash water.	V-5
	17. Stop the surface wash pump.		
	18. Close the backwash water valve, Valve No. -3.	1. Slowly, to give the filter media a chance to become hydraulically graded. 2. This should take 90-120 seconds.	
	19. Stop the backwash water pump.		
	20. Return the filter to service.	1. By opening the influent and effluent valves, and setting the rate of flow controller. 2. Initial head loss should be 12-18 inches.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
10. Abnormal Operations Filter Backwashing	*1. See Abnormal Operations for these problems.*	*1. Surface wash sweep does not rotate.* *2. Excessive flow from one area.* *3. Filter media are present in the backwash water.* *4. Excessive air is released from the filter media during backwashing.* *5. Excessive head loss when the filter is returned to service.*	
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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
11. Semiannual Activities	1. Check lubrication schedules for all equipment.	1. See Manufacturer's Data Sheet.	
	2. Have all equipment lubricated as required.	1. Coordinate with the Maintenance Crew.	
	3. Collect a core sample of the media from each filter.	1. For sieve analysis. 2. To determine the amount of interfacial mixing.	II-1 II-2 II-3 IX-2

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
12. Abnormal Operations Semiannual Activities	*1. See ABNORMAL OPERATIONS for:*	*1. Excessive interfacial mixing of filter media.*	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS OPERATION (Cont.)			
13. Sampling Program	1. Determine the type and frequency of sampling required for your plant.	1. This information will be clearly stated in the NPDES discharge permit issued by the EPA or the State water quality control agency. 2. For a 10 MGD plant, a 24-hour composite sample collected at 2-hour intervals is usually specified for suspended solids, BOD_5, and pH. 3. Grab samples will be specified for Fecal Coliforms and residual chlorine. 4. Flow measurement will be specified as continuous.	
	2. Collect and analyze samples as required.	1. For analytical procedures see the Federal Register, 38, 199, Part II, p. 28758 (16 October 1973) or contact your EPA Regional Analytical Procedures Officer.	X-2

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D. ABNORMAL OPERATIONS			
1. High Effluent Turbidity	1. Check hours of service and head loss.	1. In some cases turbidity breakthrough will occur if the filter is approaching maximum head loss, which should be after about 40-50 hours.	VII-4
	2. Collect a sample of the water before filtration.	1. For turbidity analysis, and inspection.	
	3. Closely observe the sample, and perform a turbidity analysis.	1. For the filter to produce a product water with a low turbidity, the water to be filtered must be properly coagulated and flocculated. 2. The turbidity of the water applied to the filters should be less than 5 JTU. 3. The turbidity in the water to be filtered should be floc particles, and not a haze (colloidal material). 4. If the water to be filtered is very cloudy contact the chemical treatment section, since this indicates a process control failure in the coagulation/flocculation.	
	4. Collect a sample of the filtered water.	1. For observation and turbidity analysis. 2. Use good sampling technique.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
	5. Observe the sample.	1. Filter media (sand or anthracite) in the effluent can indicate failure of the underdrain system. See Abnormal Operations - Filter Media in the Effluent.	
	6. Perform a turbidity analysis.		
	7. Check the value obtained against readings from the on-line turbidimeter.	1. These values should agree, ± 0.5 JTU. 2. If the measured turbidity is less than 1.0 JTU the filter is probably operating well; and the on-line turbidity meter needs calibration. 3. If the measured turbidity is greater than 1.0 JTU, but less than half the turbidity of the applied water, the filter is probably just dirty, and needs to be backwashed. 4. If the turbidity of the filtered water is almost equal to the turbidity of the applied water, and no filter media are present in the effluent; the filter bed may have shrunk or cracked, which can result in channeling of the filter bed. This usually occurs when the filter backwashing is inadequate to remove material from the dirty bed. The remedial action is to backwash the filters at higher flows for longer periods.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
2. Filter Media in the Filter Effluent	1. Check hours of service, head loss, and effluent turbidity.	1. The presence of sand or anthracite in the filter effluent is usually an indication of a failure of the underdrain system. This will require a complete rebuilding of the filter, which involves substantial maintenance time. 2. If an underdrain failure has occurred, the effluent turbidity will usually be very high. 3. If the underdrain failure was large the filter bed probably channeled; this is usually indicated by the no increase in head loss as the hours of service increase.	
	2. Close influent valve, Valve No. -1.	1. Before starting to drain filter.	
	3. Close effluent valve, Valve No. -6.	1. Before starting to drain filter.	
	4. Open filter drain valve, Valve No. -6.	1. Slowly, to avoid washing out as much media as possible.	
	5. Allow filter to drain completely.	1. Observe water surface as the filter drains. Usually most of the flow will be in the vicinity of the failure.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
	6. Observe surface of filter media.	1. If the underdrain failure was large enough, there will be a depression (or hole) in the filter surface.	
	7. Remove inspection plate on main drain channel.	1. If draining the filter does not indicate a problem. 2. Look for filter media in underdrain. 3. If present, the filter will have to be rebuilt.	
	8. Contact your supervisor.	1. Advise him of the problem. 2. Describe to him your findings.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
3. Excessive Initial Head Loss	1. Check initial head loss on filter.	1. About 15 minutes after the filter has been backwashed. 2. Under normal conditions this will be 12-18 inches. 3. If the initial head loss is greater than normal, the following conditions may be causing the problem: a. Zones of high head loss in the filter media. b. A partially clogged underdrain.	
	2. Backwash the filter.	1. Using the procedure described in CONTINUOUS OPERATION.	
	3. Check initial head loss.	1. It is possible that the filter was not washed clean during the last backwash. If this was the case, the initial head loss should be normal (12-18 inches) after the second wash.	
	4. Collect a core (stove pipe) sample of the filter media.	1. Carefully observe particle size distribution, and perform sieve analyses if necessary. 2. An accumulation of fines at the filter surface and/or the sand-anthracite interface. 3. If no accumulation of fines is evident, the blockage is probably in the underdrain system.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
	5. Contact the maintenance crew and your supervisor.	1. Explain your findings in detail. 2. If the underdrain system is partially plugged, super-chlorination of the backwash water will often remove scale or slime build up.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
4. Excessive Air Released During Backwashing	1. General comment.	1. This is an indication that the filter is becoming air bound.	VIII-1 VIII-2
	2. Backwash the filter very carefully.	1. To avoid losing media due to excessive turbulence. 2. Backwash water flow should be increased very slowly to avoid disrupting the filter bed.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
5. Filter Media in the Backwash Water	1. General comment.	1. The presence of filter media in the backwash water is an indication that the backwash water flow is too high.	
	2. Check filter media expansion.	1. During backwash. 2. Use a sludge blanket locater, or other suitable device. 3. Normal expansion is about 40-50 percent.	
	3. Reduce backwash water flow.	1. If expansion was greater than 50 percent. 2. By about 3 gpm/sq.ft.	
	4. Check filter media expansion.	1. To be sure the problem has been solved.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATIONS (Cont.)			
6. Excessive Flow From One Area of the Filter During Backwashing.	1. General comments.	1. This condition indicates problems with the filter media and/or the underdrain gravel. The problem could be the result of mud ball formation or incrustation.	VIII-3
	2. Backwash the filter.	1. Give it a good wash.	
	3. Rake the media.	1. With a regular garden rake. 2. In the area of high flow. 3. To brake up mud balls or incrustations.	
	4. Continue to operate the filter as usual.	1. Use caution during backwashing. 2. The filter will probably have to be rebuilt in 6 to 12 months. Notify your supervisor and the Maintenance Crew.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATION (Cont.)			
7. Surface Wash Sweep Does Not Rotate	1. Check surface wash pump.	1. Be sure it is running. 2. Be sure adequqte pressure is being produced (60-80 psig).	
	2. Try to rotate sweep.	1. By using a rake or hoe. 2. The bearing may just be stuck.	
	3. Schedule maintenance as soon as practical.	1. The filter can be backwashed without using the surface wash, but it will not be cleaned properly. 2. The filter can be operated in this manner for several days without hurting its operation. 3. Notify your supervisor.	

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OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION-OPERATING GOALS-SPECIFICATIONS	TRAINING GUIDE NOTE
E. SHUT DOWN PROCEDURES			
1. Filter Backwash	1. Backwash filter.	1. Follow the filter backwash procedure given in Continuous Operations.	
	2. Do not return the filter to service.		
	3. Leave the clean backwash water standing in the filter.	1. To keep from getting air in the bed.	

TRAINING GUIDE

SECTION	TOPIC
I	Operating Theory
II	Educational Concepts - Mathematics
III	Educational Concepts - Science
IV	Educational Concepts - Communications
V	Process Equipment
VI	Process Flow - Characterization
VII	Process Control
VII	Abnormal Operations - Trouble Shooting
IX	Maintenance Practices
X	Laboratory Practices
XI	Instrumentation - Automation
XII	Safety Practices
XIII	Records Reports

OPERATING THEORY		SECTION I
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
I-1 (B-4-5-2)	Mechanisms of Filtration a. Straining b. Sedimentation c. Flocculation d. Biological Activity e. Adsorption onto Media Surface	Fair and Geyer, pp. 656-658.
I-2 (B-4-5-2)	Filtration in Depth	Culp and Culp pp. 100-109.
I-3 (B-4-3-1)	Rate of Flow Controllers	Fair, Geyer, and Okun pp. 27-38. Urquhart, L.C. Civil Engineering Handbook, pp. 10-71, McGraw-Hill, New, York, 1962.

EDUCATIONAL CONCEPTS -- MATHEMATICS		SECTION II
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
II-1 (C-11-3-1)	Porosity The porosity of a medium is defined as the ratio of the volume of the voids to the volume of the medium.	Taylor, D.W., Fundamentals of Soil Mechanics, p. 13, John Wiley, New York, 1948.
II-2 (C-11-3-1)	Head Loss and Filter Hydraulics	Fair, Geyer, and Okun, pp. 25-15 to 27-21.
II-3 (C-11-3-1)	Uniformity Coefficient and Effective Size	Fair, Geyer, and Okun pp. 27-8 to 27-13.
II-4 (C-7-1-1)	Percent Removal of Total Suspended Solids To compute the efficiency of a filter in removing suspended solids: A. The following are known: 1. Influent TSS = 12 mg/l 2. Effluent TSS = 2 mg/l B. Compute efficiency as follows: Efficiency (%) = $\frac{12\ mg/l - 2\ mg/l}{12\ mg/l} \times 100 = 83$ percent	

EDUCATIONAL CONCEPTS - MATHEMATICS		SECTION II
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
II-5 (C-7-1-1)	Pounds of Solids Removed during a Given Time Period The total pounds of suspended solids removed by a filter over any given time period can be determined in the following manner: A. The following are known: 1. Time period is the hours of service between filter washes = 72 hours. 2. Average influent TSS = 12 mg/l 3. Average effluent TSS = 1 mg/l 4. Average flow = 8 MGD. B. Compute the removal as follows: 1. Average mg/l of TSS removed: 12 mg/l - 1 mg/l - 11 mg/l 2. lbs. removed $\frac{11 \text{ lbs.}}{1{,}000{,}000 \text{ lbs.}} \times \frac{8{,}000{,}000 \text{ gal.}}{24 \text{ hrs.}}$ $\times 72 \text{ hrs.} \times \frac{8.34 \text{ lbs.}}{\text{gal.}} = 2200 \text{ lbs. TSS removed}$	

EDUCATIONAL CONCEPTS - MATHEMATICS		SECTION II
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
II-6 (C-7-1-1)	Percent of Product Water Required for Filter Backwash The percentage of the product water required for filter backwashing may be determined as follows: A. The following are known: 1. Total gallons of water filtered = 592,000 gallons 2. Total gallons of water used for surface scour and backwash = 23,000 gallons B. Compute percent used for wash as follows: $\% = \frac{23{,}000 \text{ gals.}}{592{,}000 \text{ gals.}} \times 100 = 3.9$ percent	

EDUCATIONAL CONCEPTS - SCIENCE		SECTION III
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
III-1 (B-4-5-2)	Filters are usually very effective in removing suspended solids, but this is not always true. If the particles are very small, colloids, they will pass through the filter bed and a high effluent turbidity will result. In this case the effluent will look cloudy (or heavy) and the problem will be with the chemical treatment before filtration. This is an indication that good coagulation is not being achieved in the chemical treatment section.	

EDUCAT.ONAL CONCEPTS - COMMUNICATIONS		SECTION IV
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
IV-1 (B-4-6)	All entries in the Operator's Log should be neatly written in pencil. Any verbal instructions passed from one operator to another should also be indicated in the log, so the Chief Operator will know what was happening, and why.	
IV-2 (C-7-2-1)	The Chief Operator's Monthly Report should be clearly written and then typed, since it will become part of the permanent plant records. The report should include at least the following: 1. Plant Performance 2. Maintenance Status 3. Personnel Status and Problems 4. Needs to Continue Proper Operation 5. Suggestions to Improve Performance.	

PROCESS EQUIPMENT		SECTION V
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-1 (A-2-4-1)	By measuring the distance from the lip of the wash water through to the surface of the filter media the amount of media lost through backwashing can be easily determined. It is good practice to make the measurements about every six months.	
V-2 (B-3-3-1)	When a filter is being flooded the first time, or after it has been out of service, start the backwash water flow at a very low rate. If this is not done severe sand boils can occur, which will disrupt the media greatly. Also, air trapped in the filter media will tend to rise as large bubbles that displace large quantities of media.	
V-3 (B-3-7-1) (C-9-9-1)	The backwash water flow must be increased very slowly to prevent excessive disruption of the media and gravel. If the flow is increased too fast the media may be disturbed enough to require completely rebuilding the filter.	Water Quality and Treatment, p. 281

PROCESS EQUIPMENT		SECTION V
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-4 (B-3-7-2) (C-9-11-3)	Normal backwash water flow is difficult to precisely identify, since it is a function of the temperature of the backwash water. Most filters are washed at 19-21 gal./min./sq.ft. During backwashing the bed should be expanded 40 to 50 percent, but not so much that the sand and anthracite grains do not rub one another -- the mechanical scrubbing obtained is very important to properly washing a filter.	
V-5 (B-3-8-1) (C-9-16-1)	A filter should be washed until it is clean, but there are other considerations. If air bubbles are continuing to come from the filter, the filter should be washed longer -- even if the backwash water is very clean. The presence of air in the filter bed can result in air binding when the unit is placed in service with poor operation resulting.	

PROCESS FLOW -- CHARACTERIZATION		SECTION VI
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VI-1 (B-4-5-1)		

Typical Water Quality Data

PARAMETER	FILTER INFLUENT (mg/l)	FILTER EFFLUENT (mg/l)
Turbidity (JTU)	1.6	0.3
TSS	7	1
BOD_5	1	1
COD	23	17
TOC	12	10
TOD	17	15
NH_3-N	12.5	11.5
Org. N	0.7	0.5
NO_2 & NO_3-N	0.2	0.1
Total P	0.1	0.01
pH	7.5	7.5
MPN (per 100 ml)	0	0
Fecal Coliforms (per 100 ml)	0	0
Total Plate Count (per 1 ml)	10	3

PROCESS CONTROL		SECTION VII
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VII-1 (C-1-2-3)	Proper maintenance of the rate of flow through a filter is very important to good filter operation. The rate of flow controllers normally work very well, but the flow should be checked regularly.	
VII-2 (B-4-4-1)	The initial head loss readings obtained just after backwash should be very low (12-24 inches Water Column). A higher head loss can indicate troubles with the filter such as: a clogged underdrain, improper media installation, excessive mud ball formation, or surface sealing of the filter.	
VII-3 (B-4-5-1) (C-2-1-1)	Effluent turbidity is one of the most important process control parameters for good filter operation. An increase in effluent turbidity can be an indication of several different problems in operation such as: 1. Turbidity breakthrough resulting from a dirty filter that needs backwashing. 2. Colloidal material passing the filter resulting from the following: a. Inadequate lime dose resulting in poor coagulation and flocculation. Check with personnel operating the chemical section, and try to correct the problem.	Water Quality and Treatment, p. 257.

PROCESS CONTROL (Continued)		SECTION VII
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
	b. Improper mixing in the chemical treatment section such that good floc is not being formed or the floc is being sheared as a result of overmixing. Contact the chemical section for corrective action. 3. Application of water with a very high suspended solids concentration, generally due to loss of sludge blanket in the upflow solids contact clarifiers.	
VII-4 (D-1-1-1)	In some cases filter effluent quality can be improved by using a filter aid, such as alum or a polymer. The filter aids are usually applied in low concentrations (0.1 - 1.0 mg/l) to the water just before it reaches the filter. Very often increasing the flocculant aid feed will improve floc formation enough to prevent turbidity breakthrough.	Culp and Culp, pp. 110-113.

ABNORMAL OPERATION: TROUBLE SHOOTING		SECTION VIII
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VIII-1 (D-4-1-1)	Air Binding A decrease in filter rate and an increase in head loss are good indications that the filter is becoming air bound and the unit should be backwashed very carefully.	Water Quality and Treatment, p. 260.
VIII-2 (D-4-1-1)	A lot of air escaping from the bed during backwash indicates the filter was air bound, and the wash should be performed with great care to avoid disrupting the gravel.	
VIII-3 (D-6-1-1)	Non-uniform flow distribution across the filter surface can be an indication of serious problems such as: 1. Mud ball formation 2. Bed shrinkage 3. Clogged areas 4. Sand leakage into the underdrains 5. Air binding	Water Quality and Treatment, pp. 260-277.

MAINTENANCE PRACTICES		SECTION IX
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
IX-1 (C-3-2-2)	All maintenance requests should be made in writing--preferably on a four-part work order. One copy to be retained by the Chief Operator, one to be forwarded to the Plant Supervisor, and two copies for the Maintenance staff.	
IX-2 (C-11-3-1)	One maintenance activity that will generally improve filter operation is Yearly Super-Chlorination. After a filter has been backwashed, the filter is drained until the water level is at the top of the filter media. Chlorine solution is then added to the backwash water, and the backwash flow started at about 1.0 gpm/sq.ft. When the chlorine residual in the filter is about 1,500 mg/l the backwash flow is stopped and the filter is allowed to sit for 24 hours. This effectively removes incrustations, scale, and biological slimes. The filter is then backwashed in the usual manner and returned to service.	

LABORATORY PRACTICES		SECTION X
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
X-1 (C-3-5-1)	Turbidity Measurements	Cox, pp. 139-152.
X-2 (C-13-2-1)	Laboratory Analysis In order to comply with PL 92-500 you must report only those data which were obtained by using approved techniques. The approved techniques are listed in the Federal Register, 38, 199, Part I, p. 28758 (16 October 1973). Any technique can be used for your own in-house process control. Sources of approved techniques are: 1. Standard Methods for the Examination of Water and Wastewaters, 13th Ed. by the AWWA, APHA, and WPCF. 2. The EPA Laboratory Methods Manual. 3. 1974 Annual Book of ASTM Standards, Part 31, Water, ASTM, Philadelphia, Pa.	

INSTRUMENTATION -- AUTOMATION		SECTION XI
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XI-1 (B-4-5-2) (C-4-4-1)	Turbidity Monitoring	Water Quality and Treatment, pp. 254-257.
XI-2 (C-1-2-3)	Control of Filter Flows	Water Quality and Treatment, pp. 257-260.

SAFETY PRACTICES		SECTION XII
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XII-1 (A-1-1-1)	The SAFETY INSPECTION is the most important part of the prestart up procedures. If performed properly, the health of personnel will be secured and equipment will not be damaged.	

DALLAS WATER UTILITIES DEPARTMENT
WATER RECLAMATION RESEARCH CENTER

LABORATORY DATA SUMMARY FOR

NO. MODULE PERIOD

DATE	RUN NO.	SOURCE	Tot. Sus. Solids		Spec. Cond.		BOD		COD		Ammonia N		Organic N		NO_2 & NO_3		Nitrite N		pH		Total Phosphate		Ortho Phosphate		Alkalinity $CaCo_3$		P. Alk. $CaCo_3$		SOC	
			Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.

TYPICAL LABORATORY DATA SHEET

RECORDS -- REPORTS		SECTION XIII
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XIII-2 (B-4-3-2) (B-4-4-2) (B-4-5-1) (B-4-6) (C-7-1-1)	DALLAS WATER UTILITIES DEPARTMENT WATER RECLAVATION RESEARCH CENTER MULTIMEDIA FILTER RECORD Date: _____	TYPICAL OPERATOR'S LOG SHEET

FILTER NO. 1																FILTER NO. 2																FILTER WASH DATA											
Time	Run No.	Source	Flow, GPM	Head Loss	Rotameter	Turbidity Influent	Turbidity Effluent	Hours after last wash	Color Eff.		Run No.	Source	Flow, GPM	Head Loss	Turbidity Influent	Turbidity Effluent	Hours after last wash	Color Eff.		Filter No.	Time Out	Time In	Final Head Loss, Ft.	Initial Head Loss, Ft.	Backwash Rate, GPM	Total water used, gal.	Total Air used, cu.ft.	Surface Wash Gal. Used											

RECORDS -- REPORTS		SECTION XIII
TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XIII-3 (C-7-1-1)		TYPICAL OPERATOR'S MONTHLY SUMMARY SHEET

DALLAS WATER UTILITIES DEPARTMENT
WATER RECLAMATION RESEARCH CENTER
MULTI-MEDIA FILTER SUMMARY

Date _____

FILTER NO. 1	FILTER NO. 2
Date	Run No.
Run No.	Source
Source	Flow GPM
Flow GPM	Hours in Service/Day
Gallons Filtered	Turbidity Influent
Hours in Service/Day	Turbidity Effluent
Turbidity Influent	Color Effluent
Turbidity Effluent	Head, Initial
Color Effluent	Head, Final
Head, Initial	Hrs between Washes
Head, Final	No. Washes
Hrs. between	Wash Water Rate
No. Washes	Total Wash Water Gallons
Wash Water Rate	Total Air
Total Wash Water Gallons	
Total Air	